Operating Instructions

LonWorks FTP

VLT® 5000

VLT® 6000 HVAC

VLT® 8000 AQUA

LONMARK® 3.3

LonWorks® FTP Option Card

Instruction Manual

⚠DANGER

Rotating shafts and electrical equipment can be hazardous. Therefore, it is strongly recommended that all electrical work conform to the National Electrical Code (NEC) and all local regulations. Installation, start-up and maintenance should be performed only by qualified personnel.

Factory recommended procedures, included in this manual, should be followed. Always disconnect electrical power before working on the unit.

Although shaft couplings or belt drives are generally not furnished by the manufacturer, rotating shafts, couplings and belts must be protected with securely mounted metal guards that are of sufficient thickness to provide protection against flying particles such as keys, bolts and coupling parts. Even when the motor is stopped, it should be considered "alive" as long as its controller is energized. Automatic circuits may start the motor at any time. Keep hands away from the output shaft until the motor has completely stopped and power is disconnected from the controller.

Motor control equipment and electronic controls are connected to hazardous line voltages. When servicing drives and electronic controls, there will be exposed components at or above line potential. Extreme care should be taken to protect against shock. Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case of an emergency. Disconnect power whenever possible to check controls or to perform maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electric control or rotating equipment.

Safety Guidelines

1. The drive must be disconnected from the AC line before any service work is done.
2. The "Stop/Off" key on the local control panel of the drive does not disconnect the equipment from the AC line and is not to be used as a safety switch.
3. Correct protective grounding of the equipment must be established. The user must be protected against supply voltage and the motor must be protected against overload in accordance with applicable national and local regulations.
4. Ground currents are higher than 3 mA.

Warnings Against Unintended Start

1. While the drive is connected to the AC line, the motor can be brought to a stop by means of external switch closures, serial bus commands or references. If personal safety considerations make it necessary to ensure that no unintended start occurs, these stops are not sufficient.
2. During programming of parameters, the motor may start. Be certain that no one is in the area of the motor or driven equipment when changing parameters.
3. A motor that has been stopped may start unexpectedly if faults occur in the electronics of the drive, or if an overload, a fault in the supply AC line or a fault in the motor connection or other fault clears.
4. If the "Local/Hand" key is activated, the motor can only be brought to a stop by means of the "Stop/Off" key or an external safety interlock.

NOTE:
It is responsibility of user or person installing drive to provide proper grounding and branch circuit protection for incoming power and motor overload according to National Electrical Code (NEC) and local codes.

The Electronic Thermal Relay (ETR) is UL listed. VLTs provide Class 20 motor overload protection in accordance with the NEC in single motor applications, when VLT 6000/8000 parameter 117 (VLT 5000 parameter 128) is set for ETR Trip 1 and parameter 105 is set for rated motor (nameplate) current.

⚠DANGER

Touching electrical parts may be fatal – even after equipment has been disconnected from AC line. To be sure that capacitors have fully discharged, wait 14 minutes after power has been removed before touching any internal component.

Table of Contents

Overview

Introduction 5
About This Manual 5
Assumptions 5
What You Should Already Know 5
References 5
LonWorks Overview 6
LON Concept 6
Applications 6
VLT LonWorks Option Card 7
Node Arrangements 7
Message Passing 7
Collision Detection 8
Network Management 8
Routers and Bridges 9

Installation

Wiring Installation 10
Card Installation 10
Tools Required 10
VLT LonWorks Option Card 11
Installation Instructions 12
Network Initialization of LonWorks Option Card 19
Resource files 19

Free Topology Network Configuration

Free Topology Network Configuration 20
Network Termination Option 21
Terminator and Service Switch Locations 21
System Performance 22
System Specifications 22
Transmission Specifications 22
Free Topology Specifications 22
Doubly-terminated Bus Topology Specifications 22

Diagnostic LEDs

LonWorks Card Diagnostic LEDs 23
Status LED 23
Service LED 23
Service LED Patterns and Descriptions 24

Interface/Network Variables

VLT Adjustable Frequency Drive
and LonWorks Network Configuration 25
Network Drive Control Input 26
Drive Feedback to Network 29
Drive Status Bit Definitions 31
Network Timer Functions 33
VLT Parameter Access 34
Parameter Access Error Codes 35
Parameter Access Command and Response Examples 35
Standard Object Support 37
Alarm Descriptions 38

Parameters

Parameter List 39
Parameter Description 39

Introduction

This manual provides comprehensive instructions on the installation and set up of the LonWorks Option Card for the VLT 5000, VLT 6000 and the VLT 8000 Adjustable Frequency Drive to communicate over a LonWorks network.

For specific information on installation and operation of the adjustable frequency drive, refer to the *VLT 5000 Installation, Operation and Instruction Manual*, *VLT 6000 Installation, Operation and Instruction Manual* or *VLT8000 Installation, Operation and Instruction Manual*. Portions of this manual are printed with the permission of the Echelon Corporation and the National Electrical Contractors Association of the USA (NECA).

Echelon®, LonTalk®, Neuron® and LonWorks® are registered trademarks of the Echelon Corporation. VLT® is a registered trademark of Danfoss Inc.

About This Manual

This manual is intended to be used for both instruction and reference. It only briefly touches on the basics of the LonWorks protocol whenever it is necessary for gaining an understanding of the LonWorks profile for drives and the LonWorks Option Card for the Adjustable frequency drive.

This manual is also intended to serve as a guideline when you specify and optimize your communication system. Even if you are an experienced LonWorks programmer, we suggest that you read this manual in its entirety before you start programming, since important information can be found in all sections.

Assumptions

This manual assumes that you have a controller node that supports the interfaces in this document and that all the requirements stipulated in the controller node, as well as the Adjustable Frequency Drive, are strictly observed along with all limitations therein.

What You Should Already Know

The Danfoss LonWorks Option Card is designed to communicate with any controller node that supports the interfaces defined in this document. It is assumed that you have full knowledge of the capabilities and limitations of the controller node.

References

LonMaker™ for Windows® User's Guide.

VLT® 5000 Installation, Operation and Instruction Manual
(Referred to as the *VLT Instruction Manual* in this document.)

VLT® 6000 Installation, Operation and Instruction Manual
(Referred to as the *VLT Instruction Manual* in this document.)

VLT® 8000 Installation, Operation and Instruction Manual
(Referred to as the *VLT Instruction Manual* in this document.)

LonWorks Overview

LonWorks is both an existing standard and hardware developed by Echelon Corporation. Echelon's stated goal is to establish a commodity solution to the presently daunting problems of designing and building control networks.

The result is LonMark Interoperability which makes it possible for independent network devices to operate together over a LonWorks network. The LonMark program was developed to address interoperability issues. As a result, the LonMark Interoperability Association Task Groups (LonUsers Groups) were developed. The task groups determine that each device on the network has an object definition, create standards and models to be used by particular applications and create a common platform for presenting data. A standard network variable type (SNVT) facilitates interoperability by providing a well defined interface for communication between devices made by different manufacturers. The VLT Adjustable Frequency Drive supports the node object and controller standard object definitions of LonMark Interoperability.

Customers are currently using LonWorks for process control, building automation, motor control, elevator operation, life safety systems, power and HVAC distribution and similar intelligent building applications.

LON Concept

The LonWorks communications structure is similar to that of a local area network (LAN) in that messages are continually exchanged between a number of processors. A LonWorks system is a determined local operating network (LON). LON technology offers a means for integrating various distributed systems that perform sensing, monitoring, control, and other automated functions. A LON allows these intelligent devices to communicate with one another through an assortment of communications media using a standard protocol.

LON technology supports distributed, peer-to-peer communications. That is, individual network devices can communicate directly with one another without need for a central control system. A LON is designed to move sense and control messages which are typically very short and which contain commands and status information that trigger actions. LON performance is viewed in terms of transactions completed per second and response time. Control systems do not need vast amounts of data, but they do demand that the messages they send and receive are absolutely correct. The critical factor in LON technology is the assurance of correct signal transmission and verification.

Applications

An important LonWorks benefit is the network's ability to communicate across different types of transmission media. The NEURON chip is the heart of the LonWorks system. The NEURON chip's communication port allows for the use of transceivers for other media (such as coax and fiber optic) to meet special needs.

LonWorks control devices are called nodes. Physically, each node consists of a NEURON chip and a transceiver. With proper design, the nodes become building blocks that can be applied to control a variety of tasks, such as lighting or ventilating, integrating a variety of communications media.

The tasks which the nodes perform are determined by how they have been connected and configured. Because hardware design, software design, and network design may be independent in a LonWorks-based system, a node's function can be programmed to accommodate the networks in which it will be used.

VLT LonWorks Option Card

The Danfoss VLT LonWorks option card is comprised of a control card with a NEURON chip and a memory card. When installed into the VLT adjustable frequency drive, the unit enables the drive to communicate with other devices on the LON. The VLT drive is designed to provide precision control of standard induction electrical motors. The drive receives three reference signals along with start/stop and reset commands from the network. The drive also receives a 16-bit control word that provides full operational control of the drive. (See *Network Drive Control Input* for additional details.)

In response, the drive provides 16 output network variables containing important drive and motor data. (See *Drive Feedback to Network*.) Output to the network includes drive status, current, voltage, motor and inverter thermal status, and alarms and warnings.

LonWorks supports many different types of transmission media. A LonWorks network physical layer option can be transformer coupled twisted pair (78 kbps and 1.25 Mbps), free topology, link power, power line, RF, RS-485, fiber optic, coaxial, or infrared.

The VLT LonWorks option supports four transmission media with three versions of the VLT LonWorks option card. The VLT LonWorks option card versions are:

1. Free topology, which also operates on a link power network.
2. 78 kbps transformer coupled twisted pair.
3. 1.25 Mbps transformer coupled twisted pair.

A router is required to interface to a LonWorks network when not supported by one of the three option card versions.

Node Arrangements

LonWorks nodes can be addressed either individually or in groups. A group can contain up to 64 nodes, and one LonWorks network can support 255 groups. Furthermore, any node can be part of 15 different groups. A subnet, very similar to a group, can contain 127 nodes. A domain is the largest arrangement of nodes with a single domain able to handle 255 subnets. Thus a domain can handle 32,385 separate nodes. A single node may be connected to no more than two domains.

The group structure has the advantage of allowing a number of nodes to be reached at only one address. This method reduces the record keeping inside each chip to a minimum, allowing faster operation. However, high efficiency individual addressing can be done at all levels of a LonWorks system. The address table of a node contains entries for the group type and size and tells the node how many acknowledgments to expect when it sends a message. It also tells the NEURON chip which domain to use and the node group member number, which identifies an acknowledgment as coming from the node. The address also contains a transmit timer, a repeat timer, a retry counter, a receive timer, and the group ID.

Message Passing

There are a number of trade-offs between network efficiency, response time, security, and reliability. Generally, LonWorks defaults to the greatest degree of safety and verification for all communications over the LON network. The LonTalk protocol, built into the chips, is the operating system that coordinates the LonWorks system. It offers four basic types of message service.

The most reliable service is *acknowledged* (or end-to-end acknowledged service), where a message is sent to a node or group of nodes and individual acknowledgments are expected from each receiver. If an acknowledgment is not received from all destinations, the sender times out and re-tries the transaction. The number of retries and time-out duration are both selectable. Ac-

Message Passing (continued)

knowledgments are generated by the network host processor without intervention of the application. Transaction IDs are used to keep track of messages and acknowledgments so that the application does not receive duplicate messages.

An equally reliable service is *request/response*, where a message is sent to a node or group of nodes and individual responses are expected from each receiver. Incoming messages are processed by the application on the receiving side before a response is generated. The same retry and time-out options are available as with *acknowledged* service. Responses may include data, so that this service is particularly suitable for remote procedure call or client/server applications.

Next in reliability is *unacknowledged repeated*. Messages are sent multiple times to a node or a group of nodes with no response expected. This service is typically used when broadcasting to large groups of nodes when traffic generated by all the responses would overload the network.

The final method in reliability is *unacknowledged*, where a message is sent once to a node or group of nodes and no response is expected. This option is typically used when the highest performance is required, network bandwidth is limited, and the application is not sensitive to the loss of a message.

Collision Detection

The LonTalk protocol uses a unique collision avoidance algorithm which allows an overloaded channel to carry near to its maximum capacity, rather than reducing its throughput due to excessive collisions between messages. When using a communications medium that supports collision detection, such as twisted pair, the LonTalk protocol can optionally cancel transmission of a packet as soon as a collision is detected by the transceiver. This option allows the node to immediately retransmit any packet that has been damaged by a collision. Without collision detection, the node would wait the duration of the retry time to notice that no acknowledgment was received. At that time it would retransmit the packet, assuming acknowledge or request/response service. For unacknowledged service, an undetected collision means that the packet is not received and no retry is attempted.

Network Management

Depending on the level of a given application, a LonWorks network may or may not require the use of a network management node. A network management node performs management functions, such as:

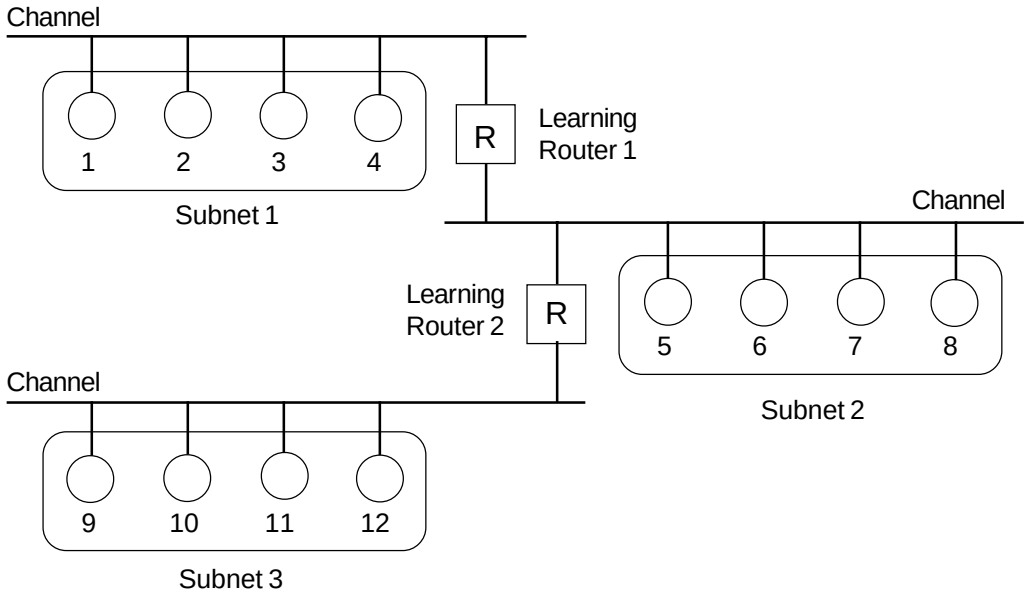
- Find unconfigured nodes and download their network addresses.
- Stop, start, and reset node applications.
- Access node communication statistics.
- Configure routers and bridges.
- Download new applications programs.
- Extract the topology of a running network.

Routers and Bridges

A router (or bridge) is a special node that consists of two connected NEURON chips, each connected to a separate channel (see figure below). Routers and bridges pass packets back and forth between these channels. There are four types of routers. A *repeater* is the simplest form of router, simply forwarding all packets between the two channels. A *bridge* simply forwards all packets which match its domains between the two channels. Using a bridge or repeater, a subnet can exist across multiple channels. A *learning router* monitors the network traffic and learns the network topology at the domain/subnet level. The learning router then uses its knowledge to selectively route packets between channels. Like a learning router, a *configured router* selectively routes packets between channels by consulting internal routing tables. Unlike a learning router, the contents of the internal routing tables are specified using network management commands.

Initially, each router sets its internal routing tables to indicate that all subnets could lie on either side of the router. Suppose that node 6, in the figure below, generates a message bound for node 2. Learning router 1 initially picks up the message. It examines the source subnet field of the message and notes in its internal routing tables that subnet 2 lies below it. The router then compares the source and destination subnet IDs and, since they are different, the message is passed on. Meanwhile, learning router 2 also passes the message on, making an appropriate notation in its internal routing tables regarding the location of subnet 2.

Suppose now that node 2 generates an acknowledgment. This acknowledgment is picked up by learning router 1, which now notes the location of subnet 1. Learning router 1 examines its internal routing tables, and, noting that subnet 2 lies below, passes the message on. When the message appears on subnet 2, it is noted by both node 6 (the destination) and learning router 2. Learning router 2 does not pass it on but merely notes that subnet 1, like subnet 2, lies somewhere above. Learning router 2 will not learn of the existence or location of subnet 3 until a message is originated from there. Subnets cannot cross routers. While bridges and repeaters allow subnets to span multiple channels, the two sides of a router must belong to separate subnets. Since routers are selective about the packets they forward to each channel, the total capacity of a system can be increased in terms of nodes and connections.



Learning Routers
Source: Echelon Corp.

Wiring Installation

Wiring

The adjustable frequency drive generates a carrier frequency with a pulse frequency between 3 kHz and 14 kHz. This results in radiated frequency noise from the motor cables. It is very important that the LonWorks cable be isolated as much as possible from the drive output cabling to the motor. Use shielded wire rather than twisted-pair. Do not run LonWorks cabling and motor cables in parallel or in close proximity to one another. Ensure that the drive is properly grounded.

Card Installation

The following section describes the installation procedures for the LonWorks option card (see following illustration). For additional information on installation and operation of the VLT adjustable frequency drive, refer to the *VLT Instruction Manual*.

⚠DANGER

VLT adjustable frequency drive contains dangerous voltages when connected to line power. After disconnecting from line, wait at least 14 minutes before touching any electrical components.

⚠WARNING

Only a competent electrician should carry out electrical installation. Improper installation of motor or VLT can cause equipment failure, serious injury or death. Follow this manual, National Electrical Code (USA) and local safety codes.

⚠CAUTION

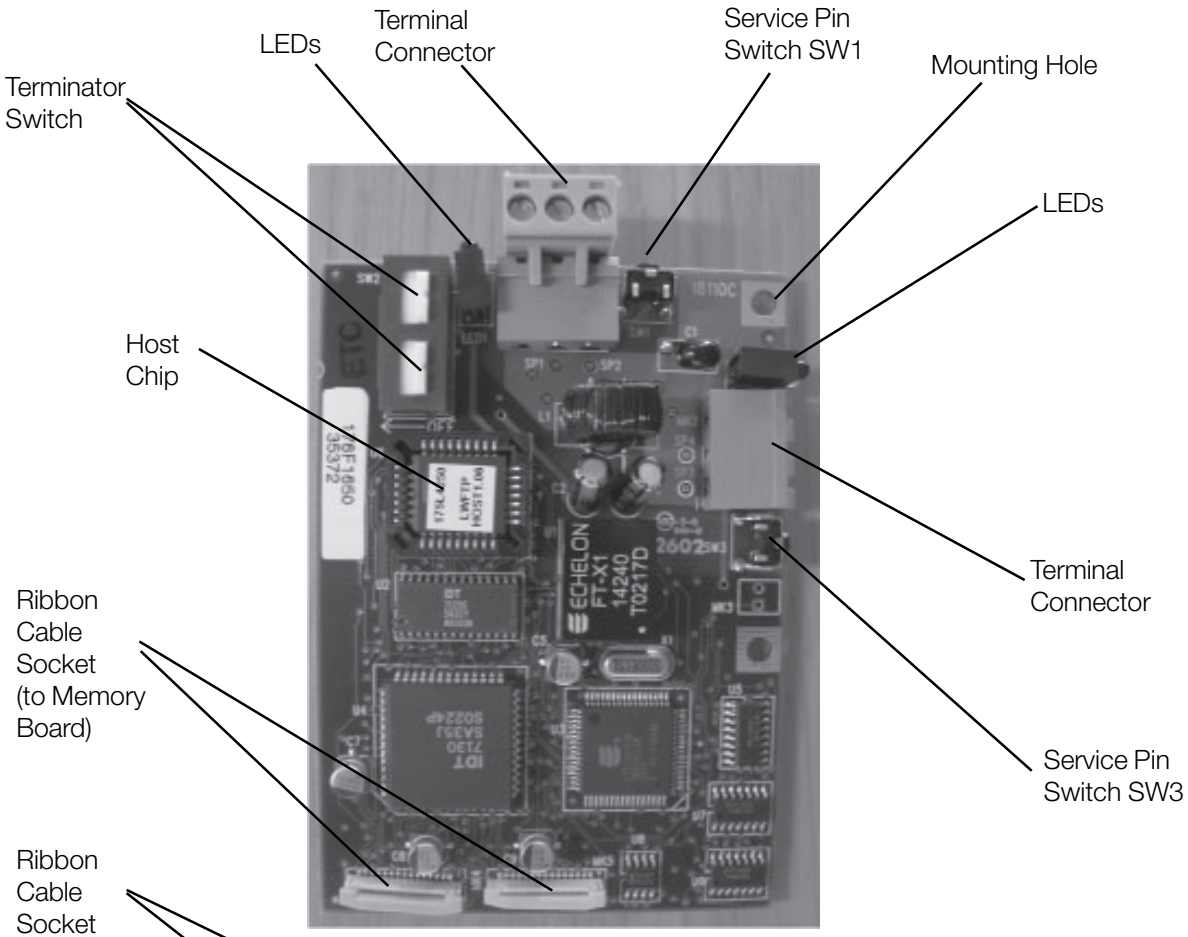
Electronic components of VLT adjustable frequency drives are sensitive to electrostatic discharge (ESD). ESD can reduce performance or destroy sensitive electronic components. Follow proper ESD procedures during installation or servicing to prevent damage.

⚠CAUTION

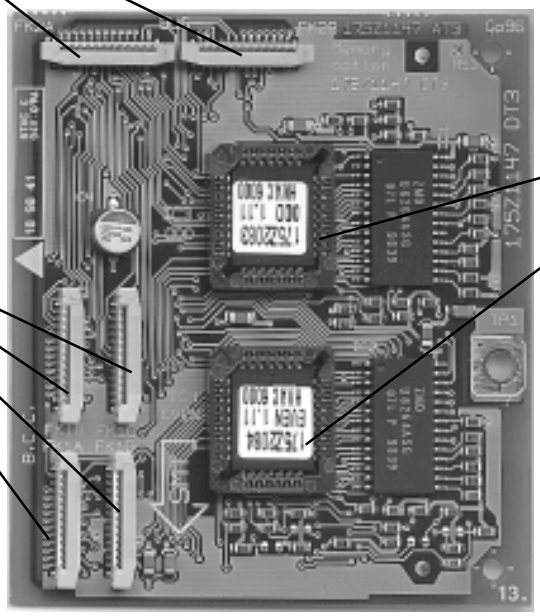
It is responsibility of user or installer of VLT adjustable frequency drive to provide proper grounding and motor overload and branch protection according to National Electrical Code (USA) and local codes.

Tools Required

Flat-head screw driver
Torx T-10 screw driver
Torx T-20 screw driver



LonWorks Control Board



Memory Board

VLT LonWorks Option Card
(Free Topology Model)

Installation Instructions

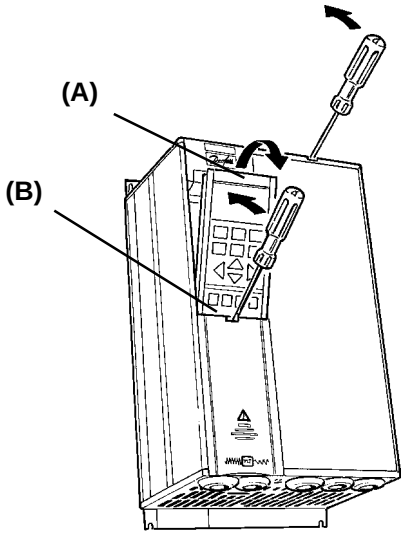
1. Access to Control Card Cassette

IP20/NEMA 1 and Bookstyle

- Remove Local Control Panel (LCP) by pulling out from top of display (A) by hand. LCP connector on panel back will disconnect.
- Remove protective cover by gently prying with a screw driver at notch (B) and lift cover out of guide pin fittings.

IP54/NEMA 12

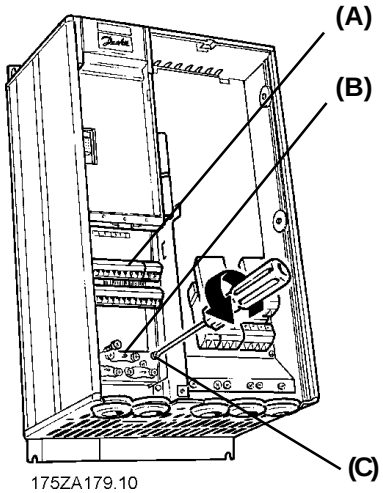
- Open front panel of drive by loosening captive screws and swing open.
- Disconnect Local Control Panel (LCP) cable from drive control card.



175ZA178.10

2. Disconnect Control Card Cassette

- Remove control wiring by unplugging connector terminals (A).
- Remove grounding clamps (B) by removing two screws holding each in place. Save screws for reassembly.
- Loosen two captive screws (C) securing cassette to chassis.



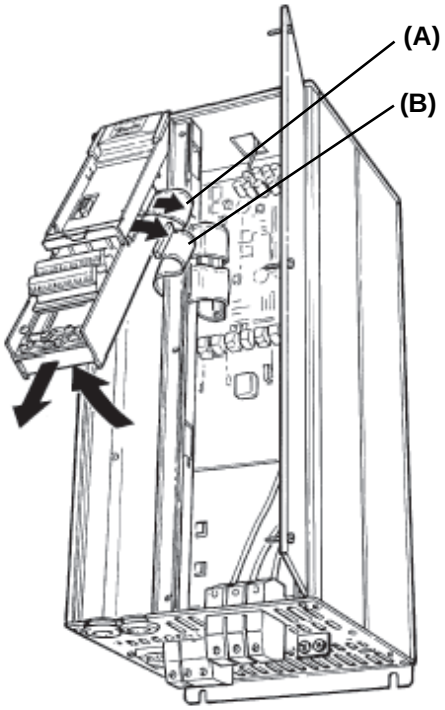
175ZA179.10

3. Remove Cassette and Ribbon Cables

- Lift control card cassette from bottom.
- Unplug two ribbon cables (A) and (B) from control board.
- Unhinge cassette at top to remove.

NOTE

Ribbon cables will need to be reconnected to same connections from which removed.

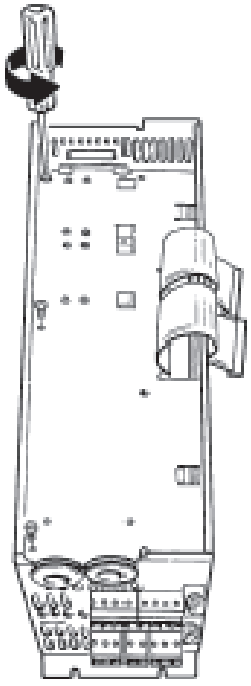


4. Chassis Ground Connections

NOTE

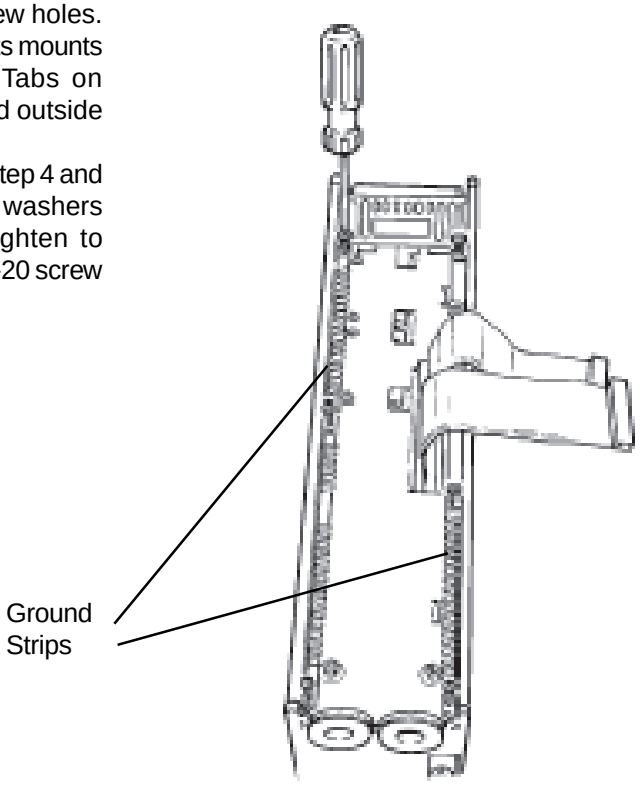
Ground strips are used on 208 V drives of 22 kW (30 HP) or less and on 460 V drives of 45 kW (60 HP) or less. For all other drives, go to step 6.

- Location of holes to mount grounding strips can vary with drive configuration. When applicable, remove mounting screws and washers located in chassis using Torx T-20 screw driver and save for reassembly. Otherwise, grounding strips attach with screws and washers provided, as shown in step 5.



5. Install Chassis Ground Connections

- Align ground strips over screw holes. Strip with fewest contact points mounts on cable side of chassis. Tabs on grounding strips point toward outside of chassis.
- Replace screws removed in step 4 and add additional screws and washers provided, as necessary. Tighten to 0.9 Nm (8 in-lbs) using Torx T-20 screw driver.

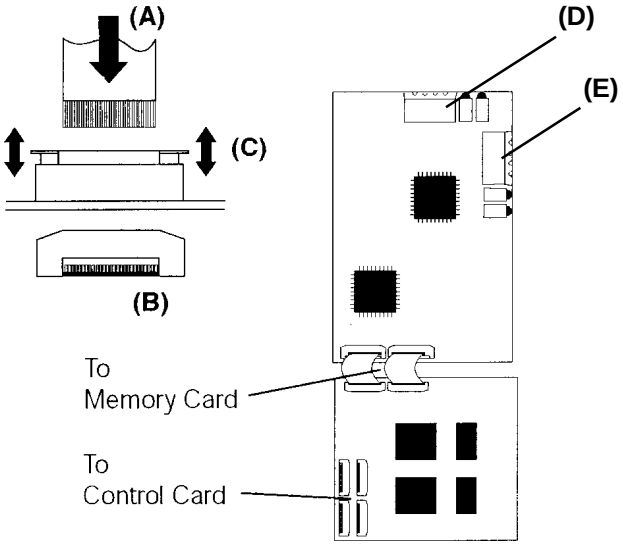


6. Install Ribbon Cables between Option Cards

- Attach ribbon cables between LonWorks control card and memory card.
- Be sure exposed wire portion of ribbon cable (A) is facing front of socket (B). Do not remove blue insulation covering end of ribbon cable.
- Pull up collar (C) of ribbon cable socket, insert cable and push collar closed.
- Repeat procedure for all ribbon cables.

IP20/NEMA 1 and IP54/NEMA 12

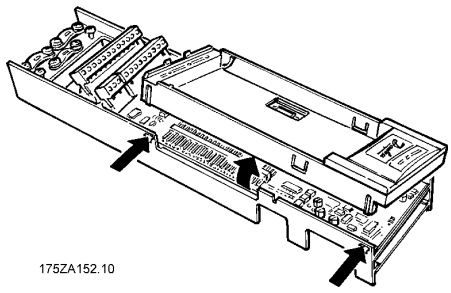
- Remove terminal connector from terminal block (D) and connect to terminal block (E) at this time for ease of access.



7. Remove LCP Cradle

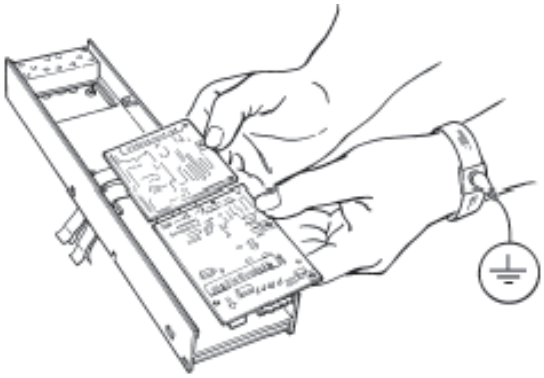
IP20/NEMA 1 and Bookstyle

- Carefully push in tabs at corners of LCP cradle to release clips. Pull out to disengage clips and lift cradle free.



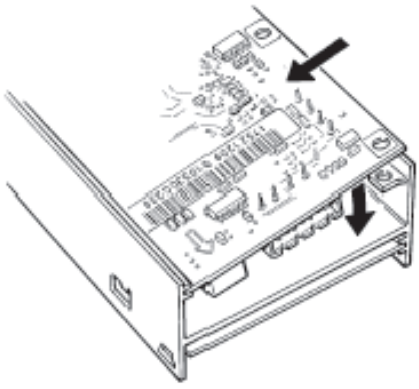
8. Ribbon Cable Routing

- Route ribbon cables from LonWorks memory card through slot at side of control board cassette.



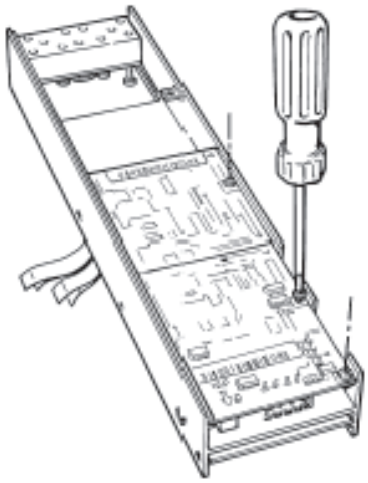
9. Insert LonWorks Card

- Insert edge of LonWorks cards into slot in side of cassette and align screw holes.



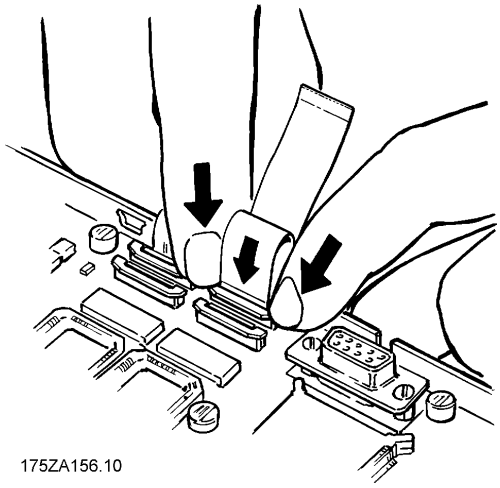
10. Secure LonWorks Card

- Secure LonWorks card with 3 self-tapping screws and washers provided using Torx T-10 screw driver. Tighten to 8 in-lbs (0.9 Nm).



11. Install Ribbon Cable on VLT Control Board

- Be sure not to twist or crimp ribbon cables.
- Insert cables into corresponding sockets and fasten in accordance with directions in step 5.

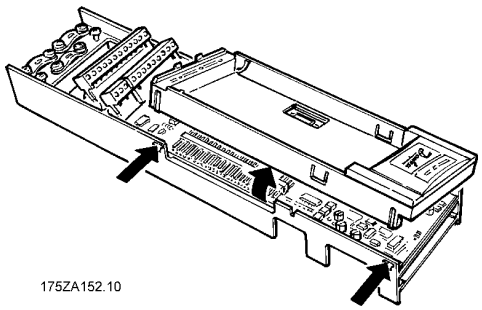


175ZA156.10

12. Install LCP Cradle

IP20/NEMA 1 and Bookstyle

- Insert cradle clips into holes in cassette.
- Push down on cradle to snap it into place.

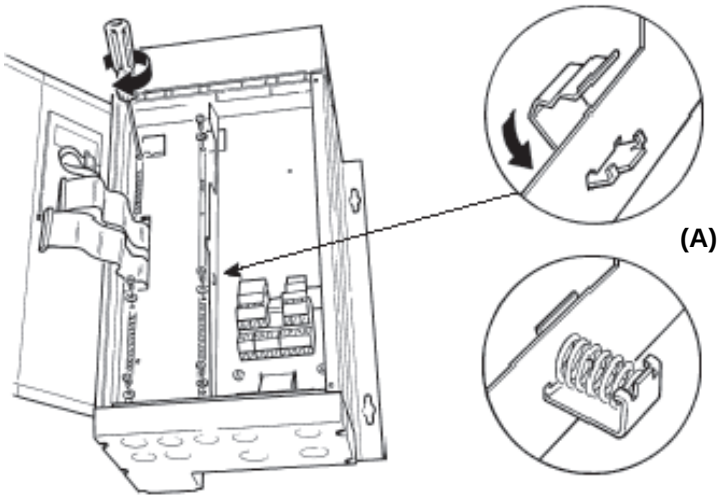


175ZA152.10

13. Install Spring Tension Clip

IP20/NEMA 1 and IP54/NEMA 12

- Spring tension clip (A) is used as a cable strain relief and ground point for shielded cable.
- Insert clip through inner wall of chassis at slot provided.
- Compress spring into clip at outer wall of chassis.

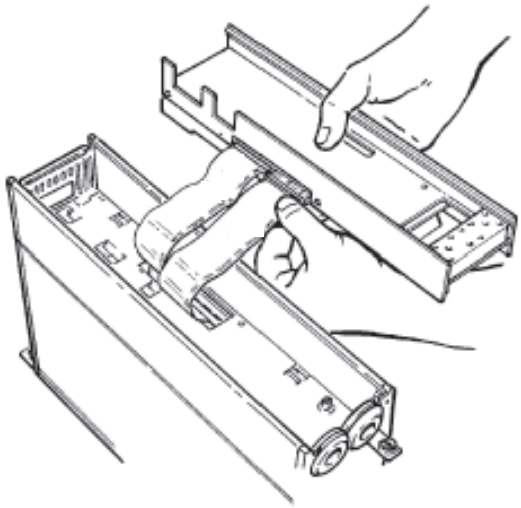


14. Install Ribbon Cables

- Connect ribbon cables.
- Connect control card cassette to hinge at top of drive and fit into chassis.

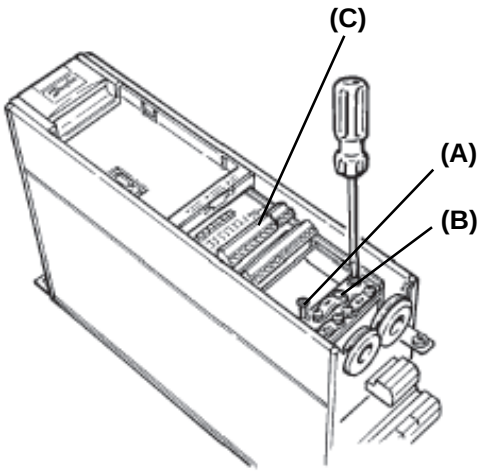
NOTE

Ribbon cables must be reconnected to same connections from which removed.



15. Install Control Card Cassette

- Fasten control card cassette by alternately tightening two captive screws (A). Tighten to 0.9 Nm (8 in-lbs).
- Route control wires through clamp fasteners (B) and secure clamps with two screws.
- Connect control terminals (C) by firmly pressing them into connector receptacles.



16. Plug in Terminal Connector

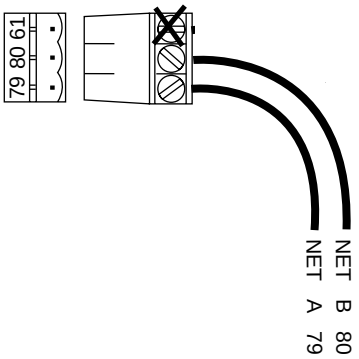
- Connect signal wire NET A to terminal 79 and NET B to 80 of terminal connector. (In free topology model, connections can be reversed.)

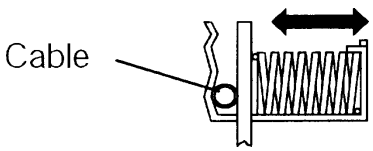
IP20/NEMA 1 and IP54/NEMA 12

- Plug network connector into terminal block at side of control card cassette.
- Insert LonWorks cable between inner wall of chassis and spring tension clip.

NOTE

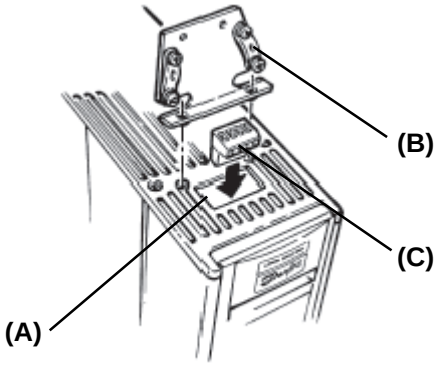
Shielded cable is recommended. Ground shielded cable at spring tension clip location or ground at cable clamp by removing cable insulation at contact point. Do not use connector terminal 61.





Bookstyle

- Remove knockout from top of drive (A).
- Route control wires through clamp fasteners (B) on cable plate and secure clamps with screws. Tighten to 0.9 Nm (8 in-lbs).
- Secure cable plate to drive with screws and screw holes provided. Tighten to 0.9 Nm (8 in-lbs).
- Plug network connector (C) into terminal block at top of control card cassette.



Network Initialization of LonWorks Option Card

The LonWorks option card contains a NEURON chip with a unique address. After hardware installation, initialize the LonWorks option card. Addressing nodes on the LonWorks network is performed at installation time by an installation tool or network management tool. Addressing requires the retrieval of a node's NEURON ID. The NEURON ID is a 48 bit number that identifies every manufactured NEURON chip. There are several methods by which the network software will initialize the drive automatically. The network can recognize the drive without action beyond proper installation. The card is then ready to be programmed for network operation. The VLT LonWorks option supports three additional methods of addressing a node:

1. *Service Pin* - There are two momentary-contact service switches that send the NEURON ID over the network. If the network software prompts the action, press either service pin (SW1 or SW3) to transmit the NEURON ID over the network. The service pin locations are shown in the illustration in *Terminator and Service Switch Locations* in this manual.

2. *Query and Wink* - The LonWorks option card is shipped with a domain of "0" and subnet of "1." Upon receiving the wink command, the on-board green status LED flashes so that the installer can locate the node. The chip sends out its Neuron ID over the network in response to the query command.

3. *NEURON ID Label* - The VLT LonWorks option card has a NEURON ID label that displays the NEURON ID as a 12 digit hexadecimal number. The installer can manually enter the NEURON ID during installation.

Resource files

A LonMark interface file (.XIF extension) provides the host processor with device information. With this, it is possible to design a LonWorks network without the adjustable frequency drive being physically present.
The resource files (VLTLON.XIF and DanfossVSD_03.*) can be downloaded from the Internet site www.danfoss.com/drives.

Echelon Corporation has also developed a set of free plug-ins available through their web site at www.echelon.com/plugin/default.htm. Also intended for network design, these plug-ins provide easy access to screens which simplify the process of manually setting up the drive, testing, and monitoring operation.

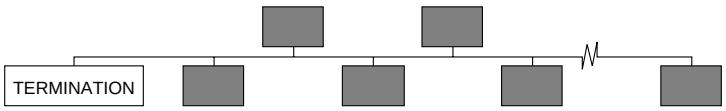
The drive may also be added to the network upon initialization.

The VLT LonWorks network interface consists of SNVTs and SCPT. The SNVTs support the LonMark Controller Profile along with VLT configuration, control and monitoring capabilities. Any combination of SNVTs can be used to operate the VLT.
We also support the Functional Profile for Variable Speed Drives version 1.1 from the LonMark organisation. This profile defines a set of Network variables (SNVT) and configuration properties (SCPT).

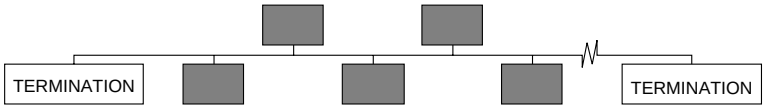
Free Topology Network Configuration

The Free Topology Transceiver (FTT) system is designed to support free topology wiring and accommodates bus, star, loop or any combination of these topologies. The FTT transceiver located on the VLT LonWorks option card provides I/O functions. Flexible wiring capability simplifies system installation and makes it easy to add nodes for system expansion. The figures below represent five network topologies.

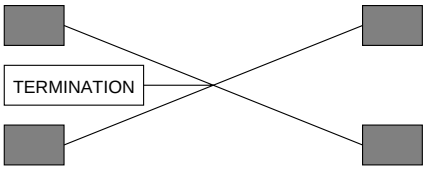
Singly Terminated Bus Loop



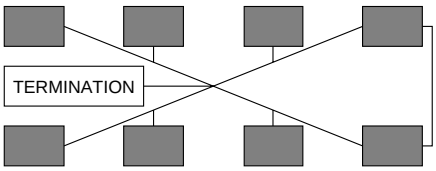
Doubly Terminated Bus Loop



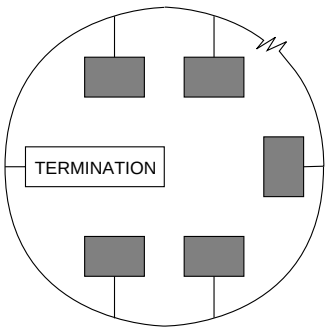
Star Topology



Mixed Topology



Loop Topology



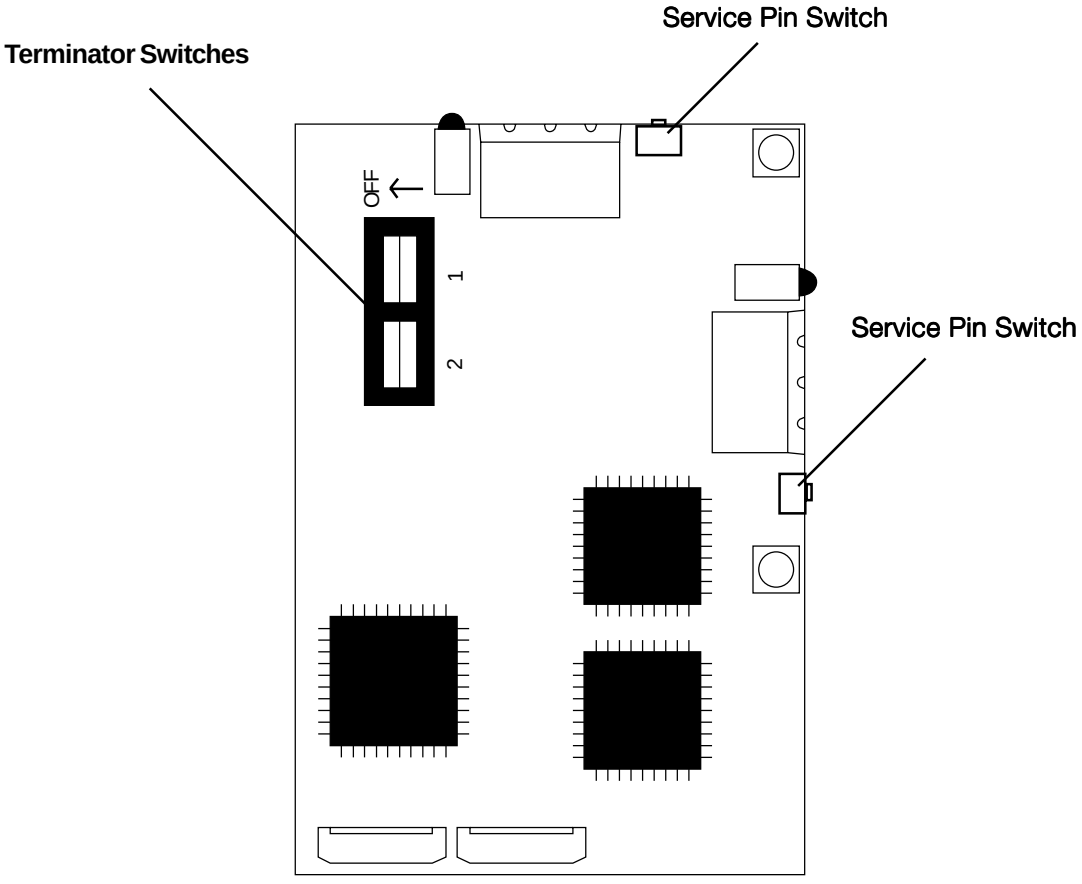
Network Termination Option

The option of using termination on the LonWorks card is provided. The option card has a termination resistor built-in which is activated by the terminator switches. Use of the terminator is optional, depending upon the network configuration. If termination is provided elsewhere in the network, the termination function should be OFF. Terminator switches position functions are provided in the table below.

Switch Position Functions

Termination	Pos 1	Pos 2
No termination	Net Term OFF (Factory setting)	Net Term OFF (Factory setting)
Single termination	Net Term ON	Net Term OFF
Double termination	Net Term ON	Net Term ON

Terminator and Service Switch Locations



Free Topology LonWorks Control Card

System Performance

Free topology system specifications and transmission specifications are described below. Both specifications should be met to ensure proper operation.

The transmission specification depends on such factors as resistance, mutual capacitance and the velocity of propagation.

The system designer may choose from a variety of cables, depending on cost, availability, and desired performance. Performance may vary with cable type. Contact Echelon for cable types and the characterization of system performance.

Note that the following specifications are for one network segment. Multiple segments may be combined using repeaters to increase the number of nodes and distance.

System Specifications

- Up to 64 FTT-10 transceivers, or 128 LPT-10 transceivers, are allowed per network segment.
- Both types of transceivers may be used on a given segment, provided that the following constraint is met: (2 x number of FTT-10 transceivers) + (number of LPT-10 transceivers) ≤128.
- The average temperature of the wire must not exceed 55° C (131° F), although individual segments of wire may be as hot as 85° C (185° F).

Transmission Specifications

Free Topology nodes run at 78 kbps transmission speeds.

Cable Specifications

Danfoss recommends the use of shielded LonWorks communication cable for instance Belden 8719. See also section 12 *Plug in terminal Connector*.

Free Topology Specifications

	Maximum node-to-node distance	Maximum total wire length
Belden 85102	500 m / 1640 ft	500 m / 1640 ft
Belden 8471	400 m / 1312 ft	500 m / 1640 ft
Level IV, 22AWG	400 m / 1312 ft	500 m / 1640 ft
JY (St) Y 2x2x0.8	320 m / 1050 ft	500 m / 1640 ft

Doubly-Terminated Bus Topology Specifications

	Maximum bus length for segments with FTT-10 transceivers only	Maximum bus length for segments with both FTT-10 and LPT-10 transceivers
Belden 85102	2700 m / 8858 ft	2200 m / 7217 ft
Belden 8471	2700 m/ 8858 ft	2200 m / 7217 ft
Level IV, 22AWG	1400 m / 4593 ft	1150 m / 3772 ft
JY (St) Y 2x2x0.8	900 m / 2952 ft	750 m / 2460 ft

LonWorks Card Diagnostic LEDs

The LonWorks board includes two LEDs to display the communication status of the board, display the state of the NEURON chip, and respond to the network management "wink" command. The onboard LEDs are the Service LED (LED 1, red) and the Status LED (LED 2, green).

Status LED

The Status LED patterns are:

ON

There is power on the board but there has not been any communication to an input network variable in the last 2 seconds.

Flashing 10 times per second

There is regular network communication to the VLT's input network variables.

Flashing intermittently

There is network communication to the VLT's input network variables but input network variables are received at a period greater than 2 seconds.

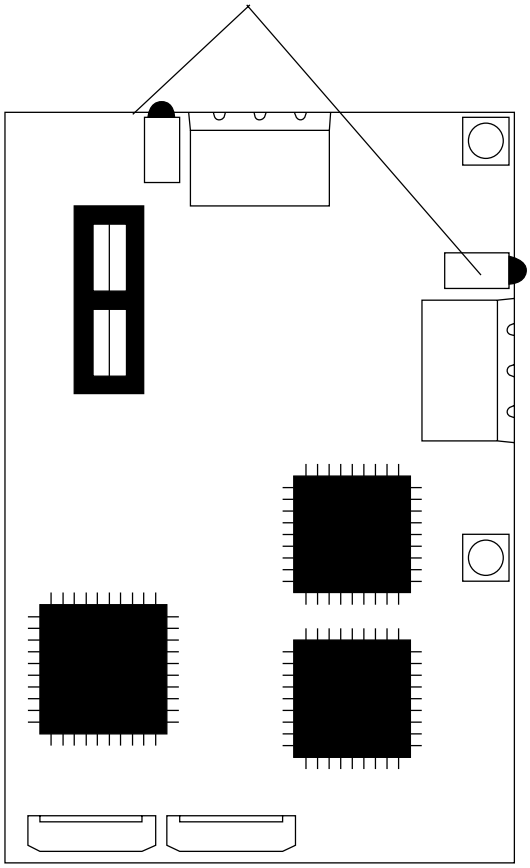
Flashing 5 times per second

The response to the network management "Wink" command. The VLT LonWorks node must be reset to leave the wink state.

OFF

No power on board or hardware fault.

LEDs



Service LED

The Service LED displays the state of the NEURON chip. The following table shows the Service LED patterns for various states and defines their meaning.

Service LED Patterns and Descriptions

LED Pattern	Operation	Description
Continuously ON	Power-up of Neuron 3120xx chip-based node or Neuron 3150 chip-based node with any PROM	Use EEBLANK and follow reinitialization procedure.
Continuously OFF	Power-up of Neuron 3120xx chip-based node or Neuron 3150 chip-based node with any PROM	Indicates bad node hardware.
ON for one second at power-up followed by approximately 2 seconds OFF, then stays ON	Power-up/Reset	May be caused by Neuron chip firmware when mismatch occurs in application checksum.
Short flash every 3 seconds	Anytime	Indicates watchdog timer resets occurring. Possible corrupt EEPROM. For Neuron 3150 chip-based node, use EEBLANK and follow reinitialization procedure.
Flashing at 1 second intervals	Anytime	Indicates node is unconfigured but has an application. Proceed with loading node.
Brief flash at power-up. OFF duration approximately 10 seconds after which stays ON	Using EEBLANK or Neuron 3150 chip-based node	Indicate completion of blanking process.
Brief flash at power-up. OFF duration approximately 1 to 15 seconds, depending on application size and system clock. LED then begins flashing at 1 second intervals.	First power-up with new PROM on Neuron 3150 chip-based custom node. Unconfigured firmware state exported.	Indicates unconfigured state.
Brief flash at power-up followed by OFF		Node is configuring and running normally.

Service LED Pattern Descriptions

Configurations properties (Nci)

The VLT LonWorks option card supports LonMark network design to improve interoperability. The Controller Object contains the VLT Adjustable Frequency Drive profile.

The configuration parameters are network variable inputs to the VLT. Configuration of parameters needs setting only one time, usually at installation.

Function	SNVT type	Variable Name	Units	VLT 6000/8000 parameter	VLT 5000 parameter
Nom. motor freq. 1)	SNVT_freq_hz	nciNmlFreq	1 Hz	104	104
Nom. motor rpm 1)	SNVT_rpm	nciNmlSpeed	1 rpm	106	106
Min. frequency 1)	SNVT_lev_percent	nciMinSpeed	0.005%	201	201
Max. frequency 1)	SNVT_lev_percent	nciMaxSpeed	0.005%	202	202
Ramp up time 1 1)	SNVT_time_sec	NciRampUpTime	1 sec	206	207
Ramp down time 1 1)	SNVT_time_sec	NciRampDownTime	1 sec	207	208
Heart beat time 1)	SNVT_time_sec	NciSndHrtBt	0.1 sec	-	-

1) Part of the LonMark Functional Profile for Variable Speed Drive 6010 version 1.1

When the NciSndHrtBt time is active it will sent the following variables:

- nvoDrvCurnt
- nvoDrvSpeed
- nvoDrvVolt
- nvoDrvPwr

Please note that nciNmlFreq and nciNmlSpeed can only be written to when the VLT frequency converter is stopped.

NOTE

Please note that writing to Configuration properties will be stored in the Non-Volatile memory.
Continous writing to Configuration properties may damage the Non-Volatile memory.

VLT 5000 parameters are shown in parenthesis, where applicable.

Network Drive Control Input

The most common functions for controlling the VLT Adjustable Frequency Drive from the LonWorks network are made readily available. Those functions and their descriptions are presented in the table below. The control word function accesses additional drive capabilities for network control.

The choice of open loop or closed loop operation of the drive is selected in parameter 100, *Configuration*.

Using nviRefPcnt, the drive's reference is expressed as a percentage of the reference range. The range is set using parameters 204, *Min. Reference* and 205, *Max. Reference*. In open loop operation, reference represents the drive's desired output speed. In this case, set *Min. Reference* to 0 Hz and *Max. Reference* equal to *Max. Frequency* in parameter 202.

In closed loop operation, reference represents the desired setpoint. It is recommended that parameters 204 and 205 be set equal to parameters 201, *Min. Frequency* and 202, *Max. Frequency*.

All references provided to the drive are added to the total reference value. If reference is to be controlled by the LonWorks bus only, ensure that all other reference inputs are zero. This means that digital input terminals and analog input terminals should not be used for reference signals. The default setting (0%) should be maintained for preset references in parameters 211 (215) through 214 (218). Also, in closed loop operation, the default setting (0.0) should be maintained for drive setpoints in parameters 418 (215) and 419 (218).

Start/Stop and *Reset fault*
SNVT_lev_disc. ST_OFF and ST_NUL are interpreted as low or "0." ST_LOW, ST_MED, ST_HIGH, and ST_ON are interpreted as high or "1."

NOTE

To optimize network performance and for proper drive operation, use only one of following input reference commands.

Reference 1
Network variable nviRefPcnt is a signed value. It represents the desired percentage of the VLT drive's reference range.
Range: -163.840 - 163.835.

Function	SNVT type	Variable Name	Units	VLT 6000/8000 parameter	VLT 5000 parameter
Start/Stop	SNVT_lev_disc	nviStartStop	Boolean	104	104
*Reset fault	SNVT_lev_disc	nviResetFault	Boolean	-	-
Reference 1	SNVT_lev_percent	nviRefPcnt	0.005%	-	-
Reference 3	SNVT_freq_hz	nviRefHz	0.1 Hz	-	-
Control word	SNVT_state	nviControlword	16 Boolean	-	-
Drive Speed Setpoint[1)]	SNVT_switch	NviDrvSpeedStpt	-	Ctrw. + Ref.	Ctrw. + Ref.
Setpoint 1	SNVT_lev_percent	NviSetpoint1	0.01%	418	215
Setpoint 2	SNVT_lev_percent	NviSetpoint2	0.01%	419	216
Bus feedback1	SNVT_lev_percent	NviFeedback1	0.01%	535	-
Bus feedback2	SNVT_lev_percent	NviFeedback2	0.01%	536	-
Analog output 42	SNVT_lev_percent	NviSetAnalog4	0.01%	364	-
Analog output 45	SNVT_lev_percent	NviSetAnalog5	0.01%	365	-

* Reset on a transition from 0 to 1. A "0" must be sent after reset to enable the next reset.

[1)] Part of the LonMark Functional Profile for Variable Speed Drive 6010 version 1.1

Network Variable Inputs to VLT

Network Drive Control Input (continued)

Reference 3
Network variable nviRefHz is an unsigned value. It represents the output frequency of the drive in Hz in open loop. It is rarely used in closed loop mode.
Range: 0 - 6553.5.

Control Word
The input network variable nviControlWord is a 16-bit word that provides additional operational control of the drive, as listed in the table below. The settings shown represent the *Coast Stop* command

Bit	Setting	0	1
00	0	Preset Ref. LSB	
01	0	Preset Ref. MSB	
02	1	DC Brake	no DC Brake
03	0	Coast Stop	no Coast Stop
04	1	Quick Stop	no Quick Stop
05	1	Freeze Freq.	no Freeze Freq.
06	0	Ramp Stop	Start
07	0	no Reset	Reset
08	0	no Jog	Jog
09	0	no function	
10	1	see Parm. 805	
11	0	Relay 1 OFF	Relay 1 ON
12	0	Relay 2 OFF	Relay 2 ON
13	0	Setup LSB	
14	0	Setup MSB	
15	0	no Reversing	Reversing

Control Word Bit Descriptions for Coast Stop

The VLT 5000 allows the choice between two control word profiles, selected in parameter 512, *Telegram Profile*. The table below defines the Profidrive control word used for transmitting commands to the drive using the Profibus protocol.

Bit	Value	0	1
00	32768	OFF 1	ON 1
01	16384	OFF 2	ON 2
02	8192	OFF 3	ON 3
03	4096	Motor coasting	Enable
04	2048	Quick stop	Ramp
05	1024	Freeze out freq.	Ramp Enable
06	512	Ramp stop	Start
07	256	No function	Reset
08	128	Jog 1 OFF	ON
09	64	Jog 2 OFF	ON
10	32	Data not valid	Valid
11	16	No function	Slow down
12	8	No function	Catch up
13	4	Setup 1 (LSB)	
14	2	Setup 2 (MSB)	
15	1	No function	Reversing

Profidrive Control Word Bit Descriptions

The equivalent control word bit settings to start and stop the drive (nviStartStop) and to reset after a fault (nviResetFault) are described in the table below.

	nviStartStop		nviResetFault		
Bit	0	1	0	1	Description
00	0	0	No value is written to the control word	0	Preset Ref LSB
01	0	0		0	Preset Ref MSB
02	1	1		1	No DC Brake
03	1	1		1	No Coast Stop
04	1	1		1	No Quick Stop
05	1	1		1	No Freeze Freq.
06	0	1		0	Start
07	0	0		1	Reset
08	0	0		0	Jog
09	0	0		0	No function
10	1	1		1	Bit 10
11	0	0		0	Relay 1 On
12	0	0		0	Relay 2 On
13	0	0		0	Setup LSB
14	0	0		0	Setup MSB
15	0	0		0	Reversing

Start/Stop and Fault Reset Control Word Bit Descriptions

NOTE

Drive always stops and ignores serial bus commands to run when OFF/STOP or STOP/RESET function is activated from drive keypad.

VLT 5000 parameters are shown in parenthesis, where applicable.

Precedence of the stop commands is:

1. Coast stop
2. Quick stop
3. DC brake stop
4. Ramp stop

Coast stop
The drive output stops immediately and the motor coasts to a stop.

- Drive display show UN.READY (unit ready) when coast stop is active.
- Drive cannot run in any mode.
- Parameter 503 (502), *Coasting stop*, determines interaction with input 27.

Quick stop
The drive output frequency ramps down to 0 Hz according to time set in parameter 207 (212), *Ramp Down Time*.

- Drive display shows STOP.
- Drive cannot run in AUTO mode but can run in HAND mode.

DC brake stop
The drive brakes the motor to a stop using DC injection braking.

- Parameters 114 (125) and 115 (126) determine amount and time of DC current applied for braking.
- Drive display shows DC STOP.
- Drive cannot run in AUTO mode but can run in HAND mode.
- Parameter 504, *DC Brake*, determines interaction with input 27.

Ramp stop
The drive output frequency ramps down to 0 Hz according to time set in parameter 207, *Ramp Down Time*.

- Factory setting is 60 sec for fan applications and 10 sec for most pump applications.
- Drive display shows STAND BY.
- Drive can run in HAND mode or AUTO through a digital input command.
- Parameter 505, *Start*, determines interaction with input 18.

Drive Speed Setpoint
With this input variable it is possible to give the Drive a Start/stop signal and a reference.

State	Ref. value	Command
0	-	Stop
1	0	Run, Ref. = 0%
1	0-100%	Run, Ref. = 0-100%
0xFF	-	Auto (invalid)

Default is Auto.

Analog output 42/45
With this input variable it is possible to control the analog output 42/45 in the range from 0-100%. To control the analog output parameter 319/321 *Signal Output 42/45* should be programmed to one of the following selections:

- Bus control 0-20 mA [44]
- Bus control 4-20 mA [45]
- Bus control Pulse [46]

Drive Feedback to Network

The VLT LonWorks option provides 22 output variables to the network containing important drive and motor feedback data. Feedback data is sent when there is a change in value. The VLT LonWorks option will only transmit bound network variables. Since some data changes continuously, the transmission rate of those variables is limited. *Min send time* specifies the minimum time between transmissions of variables.

The Drive Output 1 will have a maximum time between transmission set by the *Max send time.* This function acts as a transmit heartbeat and allows a controller node to determine the health of the controller/VLT connection. The *Max send time* function is disabled when the configuration network variable nciMaxsendT is not configured or is set to "0."

Function	SNVT type	Variable Name	Units	Max	Min
Drive status	SNVT_state	nvoDrvStatus	16 Boolean	NA	NA
Drive output 1	SNVT_lev_percent	nvoOutputPcnt	0.005%	163.835	–163.840
Current [1)]	SNVT_amp	nvoDrvCurnt	0.1 amps	3276.7	0
Energy	SNVT_elec_kwh	nvoDrvEnrg	1 kWh	65,535	0
Power [1)]	SNVT_power_kilo	nvoDrvPwr	0.1 kW	6553.5	0
Statusword	SNVT_state	nvoStatusWord	16 Boolean	NA	NA
Output voltage	SNVT_volt	nvoVoltage	0.1 V	3276.7	–3276.8
Digital input	SNVT_state	nvoDigitlInput	16 Boolean	NA	NA
Alarm	SNVT_state	nvoAlarmWord	16 Boolean	NA	NA
Warning 1	SNVT_state	nvoWarning1	16 Boolean	NA	NA
Warning 2	SNVT_state	nvoWarning2	16 Boolean	NA	NA
DC voltage	SNVT_voltage	nvoDCVolt	0.1 V	3276.7	0
Motor therm. Status	SNVT_lev_cont	nvoTempMtr	0.5 %	100	0
Inverter therm. Status	SNVT_lev_cont	nvoTempInvrtr	0.5 %	100	0
Analog input	SNVT_volt	nvoAnalog1	0.1 V	10	0
Term. 53 Analog input	SNVT_volt	nvoAnalog2	0.1 V	10	0
Term. 54 Analog input	SNVT_amp_mil	nvoAnalog3	0,1 mA	20	0
Term. 60 Running hours [1)]	SNVT_time_hour	nvoDrvRunHours	1 Hour	65534	0
Feedback	SNVT_lev_percent	nvoFeedback	0.01%	100.000	0
Frequency	SNVT_freq_hz	nvoOutputHz	0.1 Hz	6553.5	0
Drive speed [1)]	SNVT_lev_percent	nvoDrvSpeed	0.01%	100	0
Output voltage [1)]	SNVT_volt	nvoDrvVolt	0.1 V	3276.7	0

[1)] Part of the LonMark Functional Profile for Variable Speed Drive 6010 version 1.1

Network Variable Outputs from VLT

VLT 5000 parameters are shown in parenthesis, where applicable.

Drive status
NvoDrvStatus, nvoStatusWord, nvo-DigitalInput, nvoAlarmWord, nvoWarning1 and nvoWarning2 are all 16 bit Boolean values using the SNVT_state variable type. Individual bits represent specific drive status states. The tables provided in *Drive Status Bit Definitions* define each bit.

Drive output 1
Network variable nvoOutputPcnt provides an analog indication of drive operation. In open loop, this is the drive output frequency in percentage within the reference range. To avoid negative numbers, or numbers above 100%, set parameter 204, *Min. Reference* to 0 Hz, and parameter 205, *Max. Reference* equal to parameter 202*, Max. Frequency*.

In closed loop, this is the drive's feedback signal within the reference range. For best operation, set *Min. Reference* to equal parameter 413 (414), *Min. Feedback*, and *Max. Reference* to equal parameter 414 (415), *Max. Feedback.*

VLT 6000/8000 Drive Status Bit Definitions

Bit	Value	0	1
00	32768	33 OFF	33 ON
01	16384	32 OFF	32 ON
02	8192	29 OFF	29 ON
03	4096	27 OFF	27 ON
04	2048	19 OFF	19 ON
05	1024	18 OFF	18 ON
06	512	17 OFF	17 ON
07	256	16 OFF	16 ON
08	128	no function	
09	64	no function	
10	32	no function	
11	16	no function	
12	8	no function	
13	4	no function	
14	2	no function	
15	1	no function	

nvoDigitalInput

Bit	Value	0	1
00	32768	no function	
01	16384	no function	
02	8192	no function	
03	4096	no function	
04	2048	no function	
05	1024	no function	
06	512	no function	
07	256	no function	
08	128	no function	
09	64	no function	
10	32	no function	
11	16	no function	
12	8	no function	
13	4	Stopped	Running
14	2	No Warning	Warning
15	1	no Alarm	Alarm

nvoDrvStatus

Bit	Value	0	1
00	32768	Alarm	Ctrl. Ready
01	16384	Alarm	Drive Ready
02	8192	Safety Open	Safety Closed
03	4096	No Alarm	Alarm
04	2048	not used	
05	1024	not used	
06	512	not used	
07	256	no Warning	Warning
08	128	Not at Ref.	at Ref.
09	64	Hand Mode	Auto Mode
10	32	Fr. Range Warn	Freq. in Range
11	16	Stopped	Running
12	8	no used	
13	4	normal	Voltage Warn.
14	2	normal	Current lim.
15	1	normal	Therm. Warning

nvoStatusWord

Bit	Value	0	1
00	32768	normal	Unknown Fault
01	16384	normal	Trip Lock
02	8192	normal	AMA Fault
03	4096	normal	HPFB Timeout
04	2048	normal	RS-485 Timeout
05	1024	normal	ASIC Fault
06	512	normal	Short circuit
07	256	normal	SMPS Fault
08	128	normal	Ground Fault
09	64	normal	Overcurrent
10	32	normal	Current limit
11	16	normal	Mtr. Thermistor
12	8	normal	Motor thermal
13	4	normal	Undervoltage
14	2	normal	Overvoltage
15	1	normal	In. Phase loss

nvoAlarmWord

Bit	Value	0	1
00	32768	normal	Ref. High
01	16384	normal	Ctrl. Crd. Fault
02	8192	normal	Pwr. Crd. Fault
03	4096	normal	HPFB Timeout
04	2048	normal	RS-485 Timeout
05	1024	normal	Overcurrent
06	512	normal	Current limit
07	256	normal	Thermistor O.T.
08	128	normal	Motor O.T.
09	64	normal	Inverter O.T.
10	32	normal	U.V. Alarm
11	16	normal	O.V. Alarm
12	8	normal	U.V. Warning
13	4	normal	O.V. Warning
14	2	normal	Input Phase Loss
15	1	normal	Live Zero

nvoWarning1

Bit	Value	0	1
00	32768	normal	Autoramping
01	16384	normal	Start Delay
02	8192	normal	Sleep Boost
03	4096	normal	Sleep
04	2048	normal	AMA Done
05	1024	normal	AMA Running
06	512	normal	Rev. Start
07	256	no Ramp	Ramping
08	128	Forward	Reverse
09	64	not at Ref.	at Reference
10	32	Stopped	Running
11	16	Remote Ref.	Local Ref.
12	8	normal	OFF (HOA)
13	4	Auto Start/stop	Hand
14	2	normal	Run Request
15	1	Run Permission	no Run Perm.

nvoWarning2

VLT 5000 Drive Status Bit Definitions

Bit	Value	0	1
00	32768	33 OFF	33 ON
01	16384	32 OFF	32 ON
02	8192	29 OFF	29 ON
03	4096	27 OFF	27 ON
04	2048	19 OFF	19 ON
05	1024	18 OFF	18 ON
06	512	17 OFF	17 ON
07	256	16 OFF	16 ON
08	128	no function	
09	64	no function	
10	32	no function	
11	16	no function	
12	8	no function	
13	4	no function	
14	2	no function	
15	1	no function	

nvoDigitalInput

Bit	Value	0	1
00	32768	no function	
01	16384	no function	
02	8192	no function	
03	4096	no function	
04	2048	no function	
05	1024	no function	
06	512	no function	
07	256	no function	
08	128	no function	
09	64	no function	
10	32	no function	
11	16	no function	
12	8	Remote	Local
13	4	Stopped	Running
14	2	No Warning	Warning
15	1	no Alarm	Alarm

nvoDrvStatus

Bit	Value	0	1
00	32768	Alarm	Ctrl. Ready
01	16384	Alarm	Drive Ready
02	8192	Safety Open	Safety Closed
03	4096	No Alarm	Alarm
04	2048	not used	
05	1024	not used	
06	512	not used	
07	256	no Warning	Warning
08	128	Not at Ref.	at Ref.
09	64	Local	Bus Control
10	32	Fr. Range Warn	Freq. in Range
11	16	Stopped	Running
12	8	no used	Stall, Autostart
13	4	normal	Voltage Warn.
14	2	normal	Current lim.
15	1	normal	Therm. Warning

nvoStatusWord

Bit	Value	0	1
00	32768	normal	Brake Test fail
01	16384	normal	Trip Lock
02	8192	normal	AMA Fault
03	4096	normal	AMA OK
04	2048	normal	Power Up Fault
05	1024	normal	ASIC Fault
06	512	normal	HPFB Timeout
07	256	normal	RS-485 Timeout
08	128	normal	Short circuit
09	64	normal	Power Fault
10	32	normal	Ground Fault
11	16	normal	Over current
12	8	normal	Torque limit
13	4	normal	Motor Thermal
14	2	normal	Motor Overload
15	1	normal	Inverter Overload

nvoAlarmWord

Bit	Value	0	1
00	32768	normal	Brake Test Fault
01	16384	normal	Ctrl. Crd. Fault
02	8192	normal	Pwr. Crd. Fault
03	4096	normal	HPFB Timeout
04	2048	normal	RS-485 Timeout
05	1024	normal	Overcurrent
06	512	normal	Torque limit
07	256	normal	Thermistor O.T.
08	128	normal	Motor O.T.
09	64	normal	Inverter O.T.
10	32	normal	U.V. Alarm
11	16	normal	O.V. Alarm
12	8	normal	U.V. Warning
13	4	normal	O.V. Warning
14	2	normal	Input Phase Loss
15	1	normal	No motor

nvoWarning1

Bit	Value	0	1
00	32768	normal	Ramping
01	16384	normal	AMT
02	8192	normal	Start Fwd/Rev
03	4096	normal	Slow down
04	2048	normal	Catch up
05	1024	normal	FB High
06	512	normal	FB Low
07	256	normal	Current High
08	128	normal	Current Low
09	64	normal	Freq. High
10	32	normal	Freq. Low
11	16	normal	Brake Test OK
12	8	normal	Braking Max.
13	4	normal	Braking
14	2	normal	Discharge OK
15	1	normal	Out Freq. Range

nvoWarning2

Network Timer Functions

Function	SNVT type	Variable Name	Units	Max	Min	Default
Min send time	SNVT _elapsed _tm	nciMin-SendT	time	0 days 0 hours 1 min 5 sec 535 msec	0 days 0 hours 0 min 0 sec 100 msec[1] 30 msec[2]	0 days 0 hours 0 min 0 sec 500 msec
Max receive time	SNVT _elapsed _tm	nciMax-ReceiveT	time	0 days 18 hours 12 min 15 sec 0 msec	0 days 0 hours 0 min 1 sec 0 msec	0 days 0 hours 0 min 0 sec 0 msec (Off)
Max send time	SNVT _elapsed _tm	nciMax-SendT	time	0 days 0 hours 1 min 5 sec 535 msec	0 days 0 hours 0 min 0 sec 100 msec[1] 30 msec[2]	0 days 0 hours 0 min 0 sec 0 msec (Off)

[1] 78 kbps transformer coupled twisted pair and 78 Kbps free topology transceiver models.

[2] 1.25 Mbps transformer coupled twisted pair transceiver model.

Network Timer Functions

Min send time
Sets the minimum period between transmissions for all output network variables, using the network variable nciMinSendT. This function is used to keep the transmission of variables that change continuously from dominating the network communication.

Max receive time
This drive function is replaced by the value set in parameter 803, *Bus Time Out.* The LonWorks option will initiate bus time out activities when the time set in parameter 803 expires without receiving an input network variable directed to the drive. This acts like a LonWorks receive heartbeat. The action taken by the drive is determined by the setting selected in parameter 804, *Bus time out function*. See the parameter description section of this manual. The value of nciMaxReceiveT has no effect on the operation of the drive.

Max send time
This function sets the maximum time between transmissions for the network variables Drive Output 1, 2, and 3 using the configuration network variable nciMaxSendT. It can be used by the controller to monitor the health of the VLT and controller connection. It acts like a LonWorks send heartbeat.

The *Max send time* function is disabled when nciMaxSendT is not configured or set to "0."

VLT Parameter Access

A controller node can monitor or modify any VLT parameter by supporting the *Parameter access command* and the *Parameter access response* functions. These functions allow a controller complete access to the features of the VLT and the ability to configure drives with predefined settings, using the network variables nviParamCmd and nvoParamResp.

The following definitions describe how the fields of SNVT_preset are used by the VLT LonWorks option:

Learn
This field contains the function code for the VLT. The values for this field are:

LN_RECALL (0),
LN_LEARN_CURRENT (1),
LN_LEARN_VALUE (2), and
LN_REPORT_VALUE (3).

LN_RECALL (0) and
LN_REPORT_VALUE (3)
are interpreted as read commands.

LN_LEARN_CURRENT (1) and
LN_LEARN_VALUE (2)
are interpreted as write commands.

Any other value in this field will result in an error message in the *Parameter access response.*

Selector
This field contains the VLT parameter number, written in decimal notation, that is to be written or read. Requests for undefined parameters will result in an error message in the *Parameter access esponse.*

The controlling device should compare the parameter number of the response message to the requested parameter number to determine that the information received is the requested information and not a response to another controller or from another VLT.

Value
This array contains the parameter information to and from the VLT. All VLT parameters use 16 bit signed or unsigned values. The most significant 2 hex bytes of data will be stored in value [0] and the least significant 2 hex bytes of data will be stored in value [3]. In the event of an error message, the VLT will send 0xff in value [0] and an error code in value [3]. The error codes are defined in the section *Parameter Access Error Codes* in this manual.

NOTE
Consult *Conversion Index* in *the VLT Instruction Manual* parameter table for correct conversion factor for reading and writing to and from drive.

Day, Hour, Minute, Second, Millisecond
The time fields are not supported by the VLT LonWorks option. The VLT will respond to parameter access requests as soon as they are received. Any values in the time fields of the *Parameter access command* will be ignored. All time fields will be set to "0" in the *Parameter access response.*

Function	SNVT type	Variable Name
Parameter access command	SNVT_preset	nviParamCmd

Network Variable Input to VLT

Function	SNVT type	Variable Name
Parameter access response	SNVT_preset	nvoParamResp

Network Variable Output from VLT

Parameter Access Error Codes

In the event of an error message in response to a *Parameter access command* (see VLT Parameter Access), the VLT sends 0xff in value bit [0] and an error code in value [3]. Error code definitions are presented in the table below.

Parameter Access Error Codes

Exception Code	Interpretation
1	Illegal function for the addressed node
2	Illegal data address (i.e., illegal parameter number)
3	Illegal data value
6	Busy

Parameter Access Command and Response Examples

The examples below demonstrate use of the *parameter access command* and *parameter access response* functions of the controller node. In the examples, the controller node has a *parameter access command* SNVT_preset called nvoParamCmd and a *parameter access response* SNVT_preset called nviParamResp. In writing to the drive correctly, the access response simply repeats the entered data. In the event of an error, an error code is displayed in value [3]. See *Parameter Access Error Codes* above.

⚠CAUTION

Parameter 971 must be set to STORE ACTIVE SETUP for entering data values through LonWorks *parameter access command* in order to save changes in drive. See parameter 971 in *Parameter Descriptions* section of this manual.

NOTE

Consult conversion index in the *VLT Instruction Manual* parameter table for correct conversion factor for reading and writing to and from drive.

Example 1:

The controller node writes 30 seconds to parameter 206 (205), *Ramp time up* of the VLT. Conversion index is 0, so the conversion factor is 1.0 (VLT 5000 conversion factor -2)).

The controller node access command sends the following parameter write request to the VLT.

nvoParamCmd.learn=
LN_LEARN_CURRENT
nvoParamCmd.selector = 206
nvoParamCmd.value[0] = 0
nvoParamCmd.value[1] = 0
nvoParamCmd.value[2] = 0
nvoParamCmd.value[3] = 1E hex (30 decimal)

The controller node receives the following parameter access response from the VLT.

nviParamResp.learn =
LN_LEARN_CURRENT
nviParamResp.selector = 206
nviParamResp.value[0] = 0
nviParamResp.value[1] = 0
nviParamResp.value[2] = 0
nviParamResp.value[3] = 1E hex
nviParamResp.day = 0
nviParamResp.hour = 0
nviParamResp.minute = 0
nviParamResp.second = 0
nviParamResp.millisecond = 0

VLT 5000 parameters are shown in parenthesis, where applicable.

Example 2:

A controller node writes 18.0 Hz to VLT parameter 201, Output Frequency Low Limit. The conversion index is -1, so the conversion factor is 0.1.

The controller node sends the following parameter write request to the VLT.

nvoParamCmd.learn = LN_LEARN_CURRENT
nvoParamCmd.selector = 201
nvoParamCmd.value[0] = 0
nvoParamCmd.value[1] = 0
nvoParamCmd.value[2] = 0
nvoParamCmd.value[3] = B4 hex (180 decimal)

The controller node receives the following parameter access response from the VLT.

nviParamResp.learn = LN_LEARN_CURRENT
nviParamResp.selector = 201
nviParamResp.value[0] = 0
nviParamResp.value[1] = 0
nviParamResp.value[2] = 0
nviParamResp.value[3] = B4 hex
nviParamResp.day = 0
nviParamResp.hour = 0
nviParamResp.minute = 0
nviParamResp.second = 0
nviParamResp.millisecond = 0

Example 3:

A controller node writes [2] (REFERENCE [UNIT]) to parameter 007 (009), *Large Display Readout*, of the VLT.

The controller node sends the following parameter write request to the VLT.

nvoParamCmd.learn = LN_LEARN_CURRENT
nvoParamCmd.selector = 7
nvoParamCmd.value[0] = 0
nvoParamCmd.value[1] = 0
nvoParamCmd.value[2] = 0
nvoParamCmd.value[3] = 2

Time 1 - The controller node receives the following parameter access response from the VLT.

nviParamResp.learn = LN_LEARN_CURRENT
nviParamResp.selector = 7
nviParamResp.value[0] = 0
nviParamResp.value[1] = 0
nviParamResp.value[2] = 0
nviParamResp.value[3] = 2
nviParamResp.day = 0
nviParamResp.hour = 0
nviParamResp.minute = 0
nviParamResp.second = 0
nviParamResp.millisecond = 0

Example 4:

A controller node reads the value of parameter 407 (411), *Switching Frequency,* in the VLT. The value stored in parameter 407 is 10 kHz. The conversion index is 2, so the conversion factor is 100.

The controller node sends the following parameter read request to the VLT.

nvoParamCmd.learn = LN_RECALL
nvoParamCmd.selector = 407
nvoParamCmd.value[0] = 0
nvoParamCmd.value[1] = 0
nvoParamCmd.value[2] = 0
nvoParamCmd.value[3] = 0

The controller node receives the following parameter access response from the VLT.

nviParamResp.learn = LN_RECALL
nviParamResp.selector = 407
nviParamResp.value[0] = 0
nviParamResp.value[1] = 0
nviParamResp.value[2] = 0
nviParamResp.value[3] = 64 hex (100 decimal)
nviParamResp.day = 0
nviParamResp.hour = 0
nviParamResp.minute = 0
nviParamResp.second = 0
nviParamResp.millisecond = 0

VLT 5000 parameters are shown in parenthesis, where applicable.

Example 5:

A controller node error is written to VLT parameter 201, *Output Frequency Low Limit,* with 80.0 Hz when the high limit is 60 Hz. The conversion index is -1, with conversion factor 0.1.

The controller node sends the following parameter write request to the VLT.

nvoParamCmd.learn = LN_LEARN_CURRENT
nvoParamCmd.selector = 201
nvoParamCmd.value[0] = 0
nvoParamCmd.value[1] = 0
nvoParamCmd.value[2] = 3 hex
nvoParamCmd.value[3] = 20 hex (800 decimal)

The controller node receives the following parameter access response from the VLT.

nviParamResp.learn = LN_NULL
nviParamResp.selector = 201
nviParamResp.value[0] = 0
nviParamResp.value[1] = 0
nviParamResp.value[2] = 0
nviParamResp.value[3] = 3 (illegal data value)
nviParamResp.day = 0
nviParamResp.hour = 0
nviParamResp.minute = 0
nviParamResp.second = 0
nviParamResp.millisecond = 0

Standard Object Support

The VLT LonWorks option supports two standard objects and three SNVTs, per the LonMark standard object philosophy. The standard objects are the *Node Object* (containing the *Object request, Object status,* and *Object alarm)* and the *Controller object*, (containing the network variables described in the preceding sections). The *Object request* is a LonMark device used to obtain status and alarm information from a node.

It is not necessary for a controller to support the *Node Object* network variables. The *Object request, Object status* and *Object alarm* provide status and alarm information for controllers that only support this type of functionality. The status and alarm functions described in the preceding sections contain more drive specific information than *Object status* and *Object alarm.*

1. The VLT sends an *Object status* containing drive status information and an *Object alarm* containing fault informationin response to the following *Object requests*:
   RQ_NORMAL,
   RQ_UPDATE_STATUS, and
   RQ_UPDATE_ALARM.

   The nviRequest.object_id should be set to “1” (controller node). The network uses nviRequest, nvoStatus and nvoAlarm variables for these functions.

2. The VLT sends an *Object status* containing a bit map of supported status fields in response to all other *Object requests,* including undefined requests.

3. The VLT *Object status* supports the following status fields: invalid_id, invalid_request,open_circuit, out_of_service, electrical_fault, comm_failure, manual_control, and in_alarm. All other fields are always set to “0.”

4. The VLT sends an *Object alarm* following any set or reset of a drive fault condition.

5. The *Object alarm* supports the AL_ALM_CONDITION and AL_NO_CONDITION alarm types.

Function	SNVT type	Variable Name	Input/Output
Object request	SNVT_obj_request	nviRequest	Input
Object status	SNVT_obj_status	nvoStatus	Output
Object alarm	SNVT_alarm	nvoAlarm	Output

Network Variables for Node Object Support

VLT 6000/ 8000 Alarm Descriptions

Alarm numbers and descriptions that correspond to nvoAlarmWord bit numbers are shown in the table below. See the *VLT 6000/ 8000 Instruction Manual* for more details.

Bit number	Alarm number	Alarm Description
2	22	AMA failed
3	18	HPFB timeout
4	17	Serial communication timeout
5	16	Short circuit
6	15	Switch mode fault
7	14	Ground fault
8	13	Overcurrent
9	12	Current limit
10	11	Motor thermistor
11	10	Motor overtemperature
12	9	Inverter overload
13	*8	Undervoltage
14	**7	Overvoltage
15	4	Mains failure

* also bit 10 of nvoWarning 1

** also bit 11 of nvoWarning 1

VLT 5000 Alarm Descriptions

Alarm numbers and descriptions that correspond to nvoAlarmWord bit numbers are shown in the table below.

See the *VLT 5000 Instruction Manual* for more details.

Bit number	Alarm number	Alarm Description
0	23	Brake test failed
1	X	Trip locked
2	22	AMA tuning not OK
3	21	AMA tuning OK
4	20	Power up fault
5	19	ASIC fault
6	18	HPFB timeout
7	17	Standard bus timeout
8	16	Short circuit
9	15	Switch mode fault
10	14	Ground fault
11	13	Overcurrent
12	12	Torque limit
13	11	Motor thermistor
14	10	Motor overload
15	9	Inverter overload

VLT 5000 parameters are shown in parenthesis, where applicable.

★ Factory setting

Parameter List

PNU	Parameter Description	Default Value	Range	Conversion Index	Data Type
803	Bus time out	1 sec	1 - 99 sec.	0	3
804	Bus time out function	no function		0	3
805	Bit 10 function	Bit 10 = > CTW ACT		0	6
927	Parameter edit	Enable		0	6
928	Process control	Enable		0	6
970	Edit setup	Active Setup		0	5
971	Store data values	no action		0	5

In addition to the parameters listed above, the drive's control terminals issue digital inputs that control functions similar to those provided by nviStartStop, nviResetFault, and nviControlWord. Parameters (502) 503 through 508 determine how the drive responds to commands for (quick stop, VLT 5000 only), coasting stop, DC brake, start, reverse, setup select and preset reference select. See *Network Drive Control Input* in this manual and the *VLT Instruction Manual* for more information.

Parameter Descriptions

803
Bus time out

Selection:
1 - 99 sec ★ 1 sec
Function:
Sets the duration for the bus time out function. If the set time passes without the drive receiving a LonWorks message addressed to it, the drive will take the action specified in parameter 804, *Bus Time Out Function.*

NOTE
After time out counter is reset it must be triggered by valid control word before new time out can be activated.

VLT 5000 parameters are shown in parenthesis, where applicable.
★ Factory setting

804
Time out function

Selection:

★ Off
(NO FUNCTION) [0]
Freeze output frequency
(FREEZE OUTPUT FREQ.) [1]
Stop with auto restart
(STOP) [2]
Output frequency = JOG freq.
(JOGGING) [3]
Output frequency = Max. freq.
(MAX SPEED) [4]
Stop with trip
(STOP AND TRIP) [5]
Control without DeviceNet
(NO COM OPT CONTROL) [6]
Select set-up 4
(SELECT SET UP 4) [7]

Function:
The time out timer is triggered at the first reception of a valid control word, i.e., bit 10 = ok.

The time out function can be activated in two different ways:

1. The drive does not receive a LonWorks command addressed to it within the specified time.
2. Parameter 805 is set to “bit 10 = 0 time out” and a control word with “bit 10 = 0” is sent to the drive.

The VLT remains in the time out state until one of the following four conditions is true:

1. A valid control word (Bit 10 = ok) is received and the drive is reset through the bus, the digital input terminals or the local control panel. (Reset is only necessary when the time out function *Stop w/trip* is selected.) Control via LonWorks is resumed using the received control word.
2. Local control via the local control panel is enabled.
3. Parameter 928, *Access to process control*, is set to *Disabled*. Normal control via the digital input terminals and the RS-485 interface is now enabled.
4. Parameter 804, *Bus time out function*, is set to *Off.* Control via LonWorks is resumed and the most recent control word is used.

Description of Selections:

- *Freeze output frequency*. Maintain present output frequency until communication is resumed.
- *Stop with auto restart*. Stop and automatically restart when communication is resumed.
- *Output frequency = JOG freq*. Drive will produce JOG frequency set in parameter 209 (213), *Jog frequency*, until communication is resumed.
- *Output frequency = Max. freq*. Drive will produce maximum output frequency (set in parameter 202, *Output frequency*) until communication is resumed.
- *Stop with trip.* Drive stops and requires a reset command before it will restart.
- *Control without LonWorks*. Control via LonWorks is disabled. Control is possible via digital input terminals and/or standard RS-485 interface until LonWorks communication is resumed.
- *Select setup 4*. Setup 4 is selected in parameter 002 (004), *Active setup*, and settings of setup 4 are used. Parameter 002 (004) is not reset to the original value when communication is resumed.

VLT 5000 parameters are shown in parenthesis, where applicable.

★ Factory setting

805 Control Word Bit 10 Function

Selection:

	No function (NO FUNCTION)	[0]
★	Bit 10 = 1: control word active (BIT 10 = 1 >CTW ACTIVE)	[1]
	Bit 10 = 0: control word active (BIT 10 = 0 >CTW ACTIVE)	[2]
	Bit 10 = 0: bus time out (BIT 10 = 0 >TIME OUT)	[3]

Function:
According to the drive's standard communications profile, control word and speed reference will be ignored if bit 10 of the control word is *0*. Parameter 805 lets the user change the function of bit 10. This is some times necessary, as some masters set all bits to *0* in various fault situations. In these cases, it makes sense to change the function of bit 10 so that the VLT is commanded to stop (coast) when all bits are *0*.

Description of Selections:

- *No function*. Bit 10 is ignored, i.e., control word and speed reference are always valid.
- *Bit 10 = 1 >CTW active*. The control word and speed reference are ignored if bit 10 = 0.

⚠CAUTION

With *Bit 10 = 0 >CTW active* selected, nviStartStop and nviResetFault commands will not function.

- *Bit 10 = 0 >CTW active*. The control word and speed reference are ignored if bit 10 = 1. If all bits of the control word are 0, the VLT reaction will be coasting.
- *Bit 10 = 0 >time out*. The time out function selected in parameter 804 is activated when bit 10 is *0*.

---

927 Parameter edit

Data Value:

	Disable (DISABLE)	[0]
★	Enable (ENABLE)	[1]

This parameter determines if LonWorks can be used to access and edit drive parameters.

---

928 Process control

Data Value:

	Disable (DISABLE)	[0]
★	Enable (ENABLE)	[1]

This parameter determines LonWorks control of the drive. When *Enable* is selected, drive parameters 503 through 508 determine the interaction between various LonWorks and digital drive input commands. See the *VLT Instruction Manual* for details.

---

970 Edit setup select

Data Value:

	Preprogrammed	(FACTORY SETUP)	[0]
	Setup 1	(SETUP 1)	[1]
	Setup 2	(SETUP 2)	[2]
	Setup 3	(SETUP 3)	[3]
	Setup 4	(SETUP 4)	[4]
★	Active Setup	(ACTIVE SETUP)	[5]

This parameter selects the setup being edited, through either the drive control panel or LonWorks. The drive may operate in one setup while editing another. *Active setup* selects the parameter being edited as the setup controling drive operation.

---

971 Store data value

Data Value:

★	No action (NO ACTION)	[0]
	Store all setups (STORE ALL SETUPS	[1]
	Store edit setup (STORE EDIT SETUP)	[2]
	Store active setup (STORE ACTIVE SETUP)	[3]

When this parameter is set to *Store active setup*, LonWorks downloaded parameters are written to EEPROM and stored. *Store edit setup* stores the setup selected in parameter 970. *Store all setups* stores all setups in parameter 970. When finished (appx. 15 sec.), it automatically returns to *No action*. Any parameters values written via the serial bus with *No action* selected are lost when power is removed from the drive. The function is only activated with the VLT in stop mode.

★ Factory Setting

www.danfoss.com/drives

Danfoss can accept no responsibility for possible errors in catalogues, brochures and other printed material. Danfoss reserves the right to alter its products without notice. This also applies to products already on order provided that such alterations can be made without subsequential changes being necessary in specifications already agreed.
All trademarks in this material are property of the respective companies. Danfoss and the Danfoss logotype are trademarks of Danfoss A/S. All rights reserved.

175R0948 MG60N202 Rev. 2004-03-11